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## (54) RESIN COMPOSITION AND USE THEREOF

(57) A composition comprising 100 parts by weight of a polyethylene resin (A) and 2 to 5000 parts by weight of a linear ethylene-α-olefin random copolymer (B) comprising ethylene and a $C_6$-$C_{20}$ α-olefin, wherein the polyethylene resin (A) has: (a) an MFR (ASTM D 1238, 190 °C, load of 2.16 kg) of 0.1 to 200 g/10 min and (b) a density of 0.901 to 0.970 g/cm$^3$ and the copolymer (B) has: (a) density of 0.870 to 0.900 g/cm$^3$, (b) an intrinsic viscosity [η] of 0.3 to 3.0 dl/g as determined at 135 °C in decalin, (c) a glass transition temperature (Tg) of -50°C or below, (d) a crystallinity of less than 40 % as determined by X-ray diffractometry, (e) a molecular weight distribution (Mw/Mn) of 3.0 or below as determined by GPC, (f) a B value of 1.0 to 1.4 as determined by $^{13}$C-NMR spectroscopy according to a specific equation and (g) a g η* value exceeding 0.95, the g η* value being a $[\eta]/[\eta]_{blank}$ ratio wherein [η] is the above intrinsic (b) and $[\eta]_{blank}$ is the intrinsic viscosity of a linear ethylene-propylene copolymer having the same weight-average molecular weight as that of the copolymer (B) (as determined by the light scattering method) and an ethylene content of 70 mole %. This resin composition can give a molded article excellent in flexibility and tensile characteristics.

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## Description

### FIELD OF THE INVENTION

The present invention relates to a resin composition of polyethylene resin type, which is capable of providing molded products of excellent pliability (flexibility) and tensile properties.

Particularly, the invention relates to a soft resin composition containing a polyethylene resin, which has good moldability and is capable of providing molded products of excellent in pliabiity (flexibility) and strength properties.

The invention also relates to a polyethylene resin composition which is suitable mainly for packaging films and has such advantages that the composition has better film moldability as compared with conventional polyethylene resin compositions so that films can be formed at a high speed, and the composition can provide films excellent not only in mechanical strength properties (particularly tensile properties and tear strength), low-temperature heat sealability and heat-sealing stability but also in slip properties and blocking resistance thereby being excellent in suitability for high-speed filling upon packaging by automatic filling machines.

### BACKGROUND OF THE INVENTION

Examples of polyethylene resins include high-pressure low-density polyethylene resins, high-density polyethylene resins and linear low-density polyethylene resins including ethylene/α-olefin copolymers.

Of these, the low-density polyethylene resins are widely used for gaskets for injection molding machines, various packings, tubes and sheets because of their good pliability, heat resistance and mechanical strength properties.

The conventional low-density polyethylene resins have good heat resistance but show insufficient flexibility, so that they are desired to be improved in the flexibility. Besides, improvement in the mechanical strength properties, e.g., tensile properties, is also desired.

In order to improve flexibility, a method of blending the low-density polyethylene resins with various elastomers (e.g., ethylene/propylene copolymer rubber or ethylene/1-butene copolymer rubber) has been proposed.

When the low-density polyethylenes and the conventional ethylene elastomers are blended, the flexibility and the tensile properties (stress at break, elongation at break) are improved, but the level of the improvement in the tensile properties is not satisfactory.

Accordingly, development of a polyethylene resin composition capable of providing molded products of excellent in flexibility and mechanical strength properties such as tensile properties and also showing high flowability suitable for various molding methods is desired.

Of the aforesaid polyethylene resins, high-pressure low-density polyethylene resins, high-density polyethylene resins and linear low-density polyethylene resins including ethylene/α-olefin copolymers are molded into films, and the films are conventionally applied to various uses such as packaging of articles.

Of the polyethylene films, films of the linear low-density polyethylene resins including ethylene/α-olefin copolymers are used as sealants for various packaging materials, because the linear low-density polyethylene resins as film materials can be made at low energy consumpsion (i.e., smalll production cost), as compared with the conventional high-pressure low-density polyethylene resins and these films are excellent in mechanical properties such as tear strength and impact strength as well as in heat sealability through contaminants and hot tack properties.

In the uses for packaging, films are required to have suitability for high-speed filling upon packaging by the automatic filling machines, but the films made of only the linear low-density ethylene/α-olefin copolymers are not always satisfactory in the high-speed filling suitability and handling properties.

Accordingly, development of an improved resin capable of providing films having better low-temperature heat sealability, heat-sealing stability, slip properties and blocking resistance is desired.

The linear low-density ethylene/α-olefin copolymer has low melt tension for their molecular weight as compared with the high-pressure polyethylenes. Therefore, the linear low-density ethylene/α-olefin copolymer has a drawback in that, when it is formed into films at a high-speed by inflation molding, there resides problems in that rocking or breakage of bubbles is liable to occur. Further, because of poor branching in the molecular chains, the linear low-density ethylene/α-olefin copolymers have poor flowability in high shear region.

In order to solve such problems as mentioned above, various compositions and films have been proposed. For example, a composition wherein an ethylene/α-olefin copolymer is compounded with a low-crystalline ethylene copolymer having a density of not more than 0.905 g/cm$^3$ (Japanese Patent Laid-Open Publication No. 34145/1982) and a composition wherein an ethylene/α-olefin copolymer is compounded with an ethylene/vinyl acetate copolymer (Japanese Patent Laid-Open Publication No. 109543/1984) have been proposed.

However, the above problems have not been solved yet by those compositions or films thereof, and there is room left for further improvement in melt tension, flowability in high shear region, low-temperature heat sealability, mechanical strength properties such as tensile properties and tear strength, transparency and blocking resistance.

## OBJECT OF THE INVENTION

The present invention is intended to solve such problems associated with the prior art as mentioned above, and it is an object of the invention to provide a resin composition capable of providing molded products of excellent pliability (flexibility) and mechanical strength properties such as tensile properties.

It is another object of the invention to provide a soft resin composition containing a polyethylene resin, which has good moldability and can provide molded products of excellent pliability (flexibility) and mechanical strength properties such as tensile properties.

It is a further object of the invention to provide a polyethylene resin composition having excellent heat stability and high-speed moldability and capable of providing films having not only excellent in low-temperature heat sealability and heat-sealing stability but also in slip properties and blocking resistance thereby being excellent in suitability for high-speed filling upon packaging by automatic filling machines.

## SUMMARY OF THE INVENTION

The resin composition of the present invention is a composition comprising:

a polyethylene resin (A) in an amount of 100 parts by weight; and
a linear ethylene/α-olefin random copolymer (B) comprising ethylene and an α-olefin of 6 to 20 carbon atoms, in an amount of 2 to 5,000 parts by weight (in other words, the composition contains 100 parts by weight of the ethylene/α-olefin random copolymer (B) and 2 to 4,900 parts by weight of the polyethylene resin (A)),

wherein the polyethylene resin (A) has:

(a) a melt flow rate (MFR, ASTM D 1238, 190 °C, a load of 2.16 kg) of 0.1 to 200 g/10 min; and
(b) a density of 0.901 to 0.970 g/cm$^3$, and

wherein the ethylene/α-olefin random copolymer (B) has:

(a) a density of 0.870 to 0.900 g/cm$^3$;
(b) an intrinsic viscosity ($\eta$), as measured in decalin at 135 °C, of 0.3 to 3.0 dl/g;
(c) a glass transition temperature (Tg) of not higher than -50 °C;
(d) a crystallinity, as measured by X-ray diffractometry, of less than 40 %;
(e) a molecular weight distribution (Mw/Mn), as measured by GPC, of not more than 3.0;
(f) a B value, as determined by the $^{13}$C-NMR spectrum and the following equation, of 1.0 to 1.4; and
(g) a ratio $g\eta^*$ of the intrinsic viscosity ($\eta$) of this copolymer determined in the property (b) to the intrinsic viscosity $(\eta)_{blank}$ of a linear ethylene/propylene copolymer having the same weight-average molecular weight (measured by a light scattering method) as this copolymer and having an ethylene content of 70 % by mol, $(\eta)/(\eta)_{blank}$, of more than 0.95,

$$B = P_{OE}/(2P_O \cdot P_E)$$

wherein $P_E$ is a molar fraction of an ethylene component contained in the ethylene/α-olefin random copolymer, $P_O$ is a molar fraction of an α-olefin component contained therein, and $P_{OE}$ is a proportion of the number of ethylene/α-olefin alternating sequences to the number of all the dyad sequences.

The soft resin composition of the present invention is a composition comprising:

a polyethylene resin (A-α) in an amount of 100 parts by weight; and
a linear ethylene/α-olefin random copolymer (B-α) comprising ethylene and an α-olefin of 6 to 20 carbon atoms, in an amount of 50 to 5000 parts by weight (in other words, the composition contains 100 parts by weight of the ethylene/α-olefin random copolymer (B-α) and 2 to 200 parts by weight of the polyethylene resin (A-α)),

wherein the polyethylene resin (A-α) has:

(a) an MFR (MFR, ASTM D 1238, 190 °C, load of 2.16 kg) of 1 to 150 g/10 min; and
(b) a density of 0.901 to 0.970 g/cm$^3$, and

wherein the ethylene/α-olefin random copolymer (B-α) has:

(a) a density of 0.870 to 0.900 g/cm$^3$;